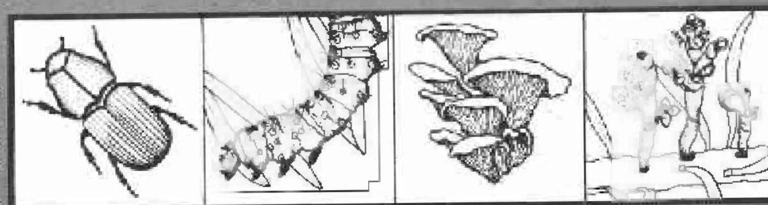
Forest Pest Management



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INSECTS AND DISEASES OF THE BRIDGER-DERBY, DEER CREEK, AND IRON MOUNTAIN MANAGEMENT UNITS BIG TIMBER RANGER DISTRICT, GALLATIN NATIONAL FOREST MONTANA

by

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INTRODUCTION

Several insect and disease pests occur on the Bridger-Derby, Deer Creek, and Iron Mountain units of the Big Timber Ranger District. Of the known pests, the western spruce budworm (*Choristoneura occidentalis* Free.) has occurred at outbreak proportions for the past 10 years. The Douglas-fir beetle (*Dendroctonus pseudotsugae* Hopk.), mountain pine beetle (*Dendroctonus ponderosae* Hopk.), and western balsam bark beetle (*Dryocoetes confusus* Sw.) have occurred at suboutbreak status during the same period of time. Major diseases that are locally damaging include root diseases of Douglas-fir and dwarf mistletoe on lodgepole pine. Even though most areas are not extensively damaged by diseases, exceptions are in portions of the Iron Mountain unit where severe root diseases occur.

At the request of the Forest, Cooperative Forestry and Pest Management prepared this report to (1) describe the current and potential insect and disease situation, (2) discuss probability of damage, and (3) provide recommendations for minimizing losses to various pests.

PEST STATUS

Insects

Insect populations have fluctuated yearly from 1978 through 1984 (Table 1). Although populations of mountain pine beetle, Douglas-fir beetle, and western balsam bark beetle have fluctuated, considerable tree mortality has occurred. For the most part, insect- and disease-caused mortality of Douglas-fir and subalpine fir is considered endemic and associated with chronic root disease centers. While mortality of lodgepole and ponderosa pine has been considered endemic, the potential for extensive tree killing is high on some habitat types. Top kill of Douglas-fir, Engelmann spruce, and subalpine fir has occurred in stands where heavy defoliation by western spruce budworm has occurred for 4-5 years. The potential is high for Douglas-fir beetle to increase in top-killed mature-overmature Douglas-fir trees, and mortality of subalpine fir from western balsam bark beetle and other engraver beetles is predicted for trees top killed by western spruce budworm.

Table 1.--Status of insect pests, Big Timber Ranger District, Gallatin National Forest, Montana 1978-1984.

	Mountain pine beetle		Western spruce budworm	Douglas-fir beetle		Western balsam bark beetle		Pine needle sheathminer
Year	Acres	Trees	Acres	Acres	Trees	Acres	Trees	Acres
1978	0	0	1,086	10	75	0	0	0
1979	50	52	388	67	165	25	0	0
1980	0	0	32,102	0	0	0	0	0
1981	1,309	229	38,759	312	87	350	60	0
1982	320	490	94,798	0	0	2,473	5,905	0
1983	157	82	110,938	0	53	234	387	0
1984	313	694	96,237	0	0	874	1,740	2,297

Table 2 provides information about insects that are now present, where outbreaks may develop, their host, characteristics of susceptible stands, and management options.

Bark beetles pose the most serious threat to mature pine stands and old-growth Douglas-fir stands. The western spruce budworm will affect management of Douglas-fir, spruce, and subalpine fir stands. Stands were hazard rated for susceptibility and risk rated for loss. These data are provided in Tables 3, and 4, and Appendix 1.

Mountain Pine Beetle

Stands were grouped by successional role for lodgepole pine and hazard rated by habitat type for probability of outbreak development (table 3). Where lodgepole pine comprised more than 20 percent of the stand basal area, and is minor seral in successional role, probability of outbreak and predicted tree mortality ranged from low to high for various habitat types. An acreage calculation for habitat type where lodgepole pine is a minor seral species in successional role is as follows:

PSME/AGSP - 55 acres
PSME/PHMA - 1,817 acres
PSME/PHMA - 11,681 acres
PSME/PHMA-CARU - 1,339 acres
PSMA/JUCO - 30 acres
PSMA/CAGE - 30 acres
PICEA/PHMA - 488 acres
PICEA/GATR - 55 acres
ABLA/CAGE-PSME - 10 acres
ABLA/CLPS - 2,284 acres

All stands with these habitat types rated low for probability of infestation and amount of tree mortality with the exception of PSME/AGSP which rated moderate with mortality of 25 to 50 percent of the lodgepole pine. The PSME/PHMA habitat type had a high probability of more than 50 percent mortality of lodgepole pine. Stands with PSME/JUCO habitat type where stands rated low to high for probability for an outbreak to develop. Tree mortality was predicted to be 25 percent in 25 percent of the stands, 25 to 50 percent in 50 percent of the stands, and over 50 percent in 25 percent of the stands. Stands of ABLA/CLPS habitat type rated moderate to high for probability of outbreak, with 33 percent of the stands receiving 25-50 percent tree mortality and 67 percent receiving over 50 percent tree mortality. Silvicultural options for

reducing losses to the beetle, depending on the age, form, and species composition of specific stands are (1) clearcut harvesting with regeneration to species other than lodgepole pine, (2) early thinning with discrimination against lodgepole pine, and (3) partial cutting of larger lodgepole pine from overstories where other species in the overstory and understory constitute a manageable stand (McGregor and Cole 1985).

In the stands where lodgepole pine is considered a major seral species, probability of outbreak ranged from low to high for the ABLA/ARCO - 358 acres, ABLA/ALSI - 100 acres, ABLA/VAGL - 553 acres, and ABLA/GATR - 117 acres.

Stands with ABLA/VASC habitat types rated moderate for probability of outbreak. Mortality of lodgepole pine in these stands is predicted as follows: ABLA/ARCO - 13 percent less than 25 percent mortality, 63 percent with 25-50 percent mortality, and 25 percent with more than 50 percent mortality; ABLA/ALSI - 43 percent with 25 percent mortality, 29 percent with 25-50 percent mortality, and 14 percent with 50 percent mortality; ABLA/VAGL - 30 percent 25 percent mortality, 13 percent - 25-50 percent mortality, and 45 percent with more than 50 percent mortality; ABLA/GATR - 13 percent with 25 percent mortality and 87 percent with more than 50 percent mortality; ABLA/VASC - all stands with 25-50 percent mortality. In these stands, outbreak prevention is largely a matter of removing the stands, or the larger lodgepole pine component, before they become highly susceptible. To accomplish such prevention while maintaining other resource values, a comprehensive long-term plan for scheduling harvests and regeneration is necessary.

In regenerating these stands, usually by clearcutting, other species can be featured. In some of these habitat types, Douglas-fir is the major species alternative to lodgepole pine, but in time will become susceptible to western spruce budworm. In this situation, it is worth considering regenerating the stand with lodgepole pine and managing it for a shorter rotation if another species alternative is not acceptable (McGregor and Cole 1985).

<u>Douglas-fir beetle</u>

Stands were hazard rated for susceptibility to Douglas-fir beetle. Presently stand susceptibility classifications are based on characteristics associated with past outbreaks. Furniss et al. (1979) stated stand susceptibility is positively correlated with the proportion of Douglas-fir in the stand, its density, and its age. Any of these factors can limit damage, but high density can result in somewhat younger trees being attacked.

Furniss et al. (1981) have identified individual tree susceptibility characteristics as well as those factors which seem to delimit susceptible stands. Trees on which attacks are more dense and successful are those which are older, larger, more dominant, and more productive of attractant resins. Stand characteristics linked with susceptibility are (1) density, (2) species diversity, (3) habitat type, (4) stand age, (5) disease, and (6) injuries.

<u>Density:</u> Density-related factors reflect the importance of moisture stress and shaded stem environment. The denser the stand, the higher the susceptibility to the beetle.

Table 2.—Insects, hosts, factors contributing to stand susceptibility and management options.

INSECTS AFFECTING OLD-GROWTH STANDS

Damaging agent	Host	Highly susceptible stand characteristics	Infestation present	Damage	Management options
Western spruce budworm	Douglas-fir Engelmann spruce Subalpine fir	Pure stands of tolerant tree species, overstocked, mature multistoried stands	Yes	Growth loss topkilling tree mortality	Pesticides, silviculture (CC, ST, SHEL)[1]
Mountain pine beetle	Lodgepole pine	Greater than 8 inches d.b.h., >80 yrs. of age, pure stands, elevation and latitude conducive to population increase	Yes	Tree mortality	Silviculture (CC, ST, SHEL, SEL) baiting, trapping, preventive sprays, lethal trap trees, fell & burn
	Ponderosa pine	Pure evenaged, 50-100 yrs. old, 8-12 inches d.b.h., >150 ft^2 basal area/acre	Yes	Tree mortaltiy	Silviculture (SEL, SHEL, ST)
Douglas-fir beetle	Douglas-fir	Windthrow, snowbroken trees, fire damaged, >100 yrs. of age, >10 inches d.b.h., 230 ft^2 basal area/acre; stands defoliated by western spruce budworm	Yes	Tree mortality	MCH, baiting & trapping, salvage of windthrow, commercial thinning (ST, SHEL, SEL)
Western balsam bark beetle	Subalpine fir	Stands defoliated by western spruce budworm; old-growth fir infected with root disease; windthrow	Yes	Tree mortality	Salvage windthrow, baiting & trapping, silviculture (CC, SEL, SHEL)

[1]CC - clearcut; ST - seed tree; SHEL = shelterwood; SEL = selective cut

Table 2, continued

Damaging agent	Host	Highly susceptible stand characteristics	Infestation present	Damage	Management options
Pityogenes & Pityophthorus	Lodgepole pine	Injured or diseased trees, trees infested with mpb	Yes	Tree mortality	Remove diseased or injured trees, silviculture (SEL)
Ips spp.	Lodgepole pine Ponderosa pine	Slash, injured or windthrown trees	No	Mortality of pole-sized trees	Proper slash disposal and stand maintenance
Lodgepole terminal weevil	Lodgepole pine	Open-grown even-aged stands on better growing sites. Trees <30 ft. tall, <25 yrs. of age	Yes	Reduce height growth, permanent crooks in stems, stag-headed crowns	Silviculture stand spacing, pruning terminals, pine oil.
Lodgepole needle miner	Lodgepole pine	Mature, pure stands	No	Growth loss, predispose trees to other insects, tree mortality	Pesticides

INSECTS AFFECTING REPRODUCTIVE STRUCTURES

Damaging agent	Host	Highly susceptible stand characteristics	Infestation present	Damage	Management options
Dioryctria spp.	Douglas-fir Ponderosa pine	Cones	Yes	Cone destruction	Pesticides
Western spruce budworm	Douglas-fir	Cones	Yes	Cone destruction	Pesticides

Table 3.--Area of habitat type represented by successional role, mountain pine beetle hazard rating, and predicted mortality for lodgepole pine, Bridger-Derby Units.

Successional role	Habitat type	Acres	Percent with no LPP	Hazard rating	Predicted tree mortality % 25	25-50	50
Minor seral	PIPO/FEID	13	100	L	0	0	0
	PIPO/AGSP	20	100	L	0	0	0
	PSME/AGSP	55	0	M	0	100	0
	PSME/PHMA	1,817	50	H	0	0	50
	PSME/FIED	214	100	L	0	0	0
	PSME/PHMA-PHMA	11,681	50	L	50	0	0
	PSME/PHMA-CARU	1,339	0	L	20	0	0
	PSME/JUCO	30	0	L-H	25	50	25
	PSME/CAGE	30	0	L	100	0	0
	PSME/SYAL-SYAL	70	100	L	0	0	0
	PSME/SYAL-CARU	277	0	L	0	0	0
	PSME/SPBE	Trace	0	L	100	0	0
	PICEA/PHMA	488	50	L	50	0	0
	PICEA/GATR	55	0	L	100	0	0
	PIAL/ABLA	178	100	L	0	0	0
	ABLA/CAGE-PSME	10	33	L	67	0	0
	ABLA/CLPS	2,284	0	M-H	0	33	67
Major seral	PSME/CARU	62	100	L	0	0	0
	ABLA/ARCO	358	0	L-H	13	63	25
	ABLA/ALSI	100	14	L-H	43	29	14
	ABLA/VAGL	5,532	13	L-H	30	13	45
	ABLA/GATR	117	13	L-H	13	0	87
	ABLA/VASC	515	0	M	0	100	0
	ABLA/CARU	205	0	M-H	0	20	80
	ABLA/VACA	123	0	H	0	0	100

<u>Species diversity and habitat type:</u> Epidemics are more prevalent in pure, dense communities that are rather homogenous in age and species. No definitive correlation between habitat type and beetle mortality has yet been developed; however, two of the more susceptible habitat types in northern Idaho are grand fir/pachistima and western redcedar/pachistima. In western Montana, infestations are more frequent on Douglas-fir/ninebark habitat type. Little mortality has been observed on Douglas-fir/elksedge habitat types or on most of the subalpine fir habitat types in which Douglas-fir is seral.

<u>Stand age:</u> Average age of most trees killed exceeds 120 years. However, during epidemics, trees as young as 90 years can be infested and killed. Usually trees this young are successful in resisting beetle attack.

<u>Disease:</u> Most workers agree that there is a relationship between root-diseased Douglas-fir and endemic populations of Douglas-fir beetle, but not during beetle epidemics. The onset of root disease in mature trees probably contributes to their beetle susceptibility by increasing moisture stress.

Injuries: Injuries such as fire, wind and snow breakage, and insect defoliation are frequently responsible for predisposing trees or stands to beetle attack. Any of these factors which substantially reduce tree vigor will render the trees more attractive and susceptible to beetle depredation.

A summary of hazard rating stands by habitat type for probability of outbreak is shown in Table 4.

Table 4.--Hazard rating of stands by habitat type for probability of outbreak for Douglas-fir beetle, Bridger-Derby Areas.

		Hazard Rating		
		Percent in each hazard class		
	Habitat type	Low	Moderate	High
Minor seral	PSMA/PHAM	73	17	10
	PSME/PHAM-PHMA	66	23	9
	PSME/PHMA-CARU	43	57	0
	PSME/SYAL-SYAL	0	0	100
	PSME/SPKE	0	0	100
	PSME/JUCO	0	50	50
	PICEA/PHMA	75	25	0
	PICEA/GATR	100	0	0
	ABLA/CLPS	100	0	0
Major seral	PSME/CARU	100	0	0
	PSME/CAGE	67	33	0
	PSME/CAGE	67	33	0
	ABLA/GATR	0	100	0
	ABLA/VACA	48	29	24
	ABLA/VASC	100	0	0
	ABLA/VASC-VASC	50	50	0
	ABLA/CARU	259	100	0
	ABLA/ARCO	25	50	25

Resistance to population expansion is increased as (1) susceptible trees are killed, (2) stand density is reduced through logging, or (3) environmental conditions are improved to increase tree growth. Size of infested groups declines and a higher proportion of attacked trees survives following the first year green stands are infested with beetles emerging from windthrow. At that point natural enemies play a bigger role in further reducing beetle populations. Populations are then maintained at endemic levels through the forces of host resistance and natural enemies until conditions conducive to population buildup occur once again.

Western Spruce Budworm

The primary damage caused by the western spruce budworm, in terms of timber values, is reduced volume. Budworm feeding will reduce periodic annual increment approximately 24 percent of expected growth. Most of the mortality caused by budworm is in the smaller trees, but continued decline of vigor in larger trees often creates favorable conditions for secondary beetle attacks.

Stands in the area of concern were hazard rated using the Wulf-Carlson[1] method which integrates nine stand variables to create an index rating from 0-100. We have considered all values less than 15 to be low, 15-29 to be moderate, and over 30 to be high. Appendix 1 classifies each stand for susceptibility to budworm.

Disease Situation

Forest diseases are generally not severe throughout most of the Big Timber Ranger District. Major diseases within the District include root disease on Douglas-fir and subalpine fir and dwarf mistletoe on lodgepole pine.

Most areas within timber subcompartments 107-111 are not extensively damaged by diseases. Exceptions occur in portions of subcompartments 109-01, 109-02, 109-03, and 108-03 where severe root diseases occur. Major pathogens associated with these root diseases include *Phaeolus schweinitzii* on Douglas-fir and *Armillaria mellea* on subalpine fir and Douglas-fir. Root diseases of Douglas-fir have resulted in large centers of mortality that are especially common on south- and west-facing slopes. Disease centers have been present for many years; past tree mortality may have been associated with adverse climatic factors such as periods of drought or perhaps wave years of budworm defoliation. Recent mortality on the edge of disease centers was not prominent, indicating that the disease was not spreading rapidly.

Several other diseases have been noted in the area, most of which are of very minor importance. These include *Lophodermella concolor* needlecast of lodgepole pine, western gall rust (*Endocronartium harkenssii*) of lodgepole pine, broom rust (*Chrysomyxa arctostaphyli*) on Engelmann spruce, and *Rhabdocline pseudotsugae* needlecast on Douglas-fir.

The major diseases to be addressed in management activities are root diseases and dwarf mistletoes. Since root diseases are caused by persistent pathogens and are site specific, control is difficult. The major root pathogen involved, *P. schweinitzii*, is not an aggressive tree killer, but will cause decay and accelerated decline of weakened trees over time. Therefore, we suspect that the level of root disease currently found in some stands would be greatly reduced if stands were brought under management with proper tree spacing, species mixtures, and age class distribution. The best approach to converting existing root-diseased sites into productive timber stands is to treat disease centers initially and improve tree vigor in areas between centers. Therefore, we suggest clearcutting root disease centers and adjacent decadent stands and planting primarily ponderosa and lodgepole pine. This will likely entail some large clearcuts which may exceed regional standards. However, without treatment, diseased stands will continue to deteriorate and remain unproductive.

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[1] CANUSA workshop August 1984.

Although emphasis should be placed on converting severely root-diseased sites to pine, Douglas-fir will likely reinvade clearcut areas. This will be satisfactory if species mixtures and proper tree spacing are maintained during intermediate silvicultural treatments. If resulting stands are vigorous and thinned at proper intervals, expected root-disease damage will be minimal. This is especially true if adequate measures are taken to reduce periodic budworm damage.

Dwarf mistletoes are scattered throughout several stands of lodgepole pine in compartments 107-111. This disease has occurred in most of these stands for many years and will continue to spread and intensify unless proper treatments are instituted. Forest-wide estimates indicate that about 42 percent of the lodgpeole pine stands are infested (Dooling 1979). This disease accounts for volume losses of about 7.6 ft^3/acre/year or total losses of 502.2 M ft^3/year.

Guidelines for reducing losses from dwarf mistletoes have been published by Dooling and Brown (1976). In general, severely infected stands should be clearcut, with care taken to reduce potential infection of regeneration. Lightly infected stands may be sanitized, if practical. It is important that infected individual trees within or adjacent to clearcuts be removed to reduce risk of infecting regeneration. Properly treating infested stands will guarantee absence of dwarf mistletoes indefinitely.

In conclusion, the major disease problems in compartments 107-111 can be alleviated by first identifying existing and potential problem stands and then modifying silvicultural prescriptions to reduce future damage. Root diseases will be the most difficult to deal with, but feasible procedures are available which will return diseased stands to productivity. The sooner diseased stands are treated, the sooner they will become productive.

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APPENDIX 1

Spruce budworm stand hazard rating for susceptibility to infestation.

Comp.	Sub-comp.	Stand	Comp.	Sub-comp.	Stand	Comp.	Sub-comp.	Stand
	Low			Moderate			High	
104	02	04	104	03	08	104	03	06
104	02	05	104	06	01	105	01	10
104	03	07	104	06	03	105	01	11
105	01	09	107	01	48	105	02	05
107	01	22	107	01	53	107	01	23
107	01	61	107	01	57	107	01	50
107	01	62	107	02	13	107	01	51
107	01	65	107	02	14	107	01	52
107	01	69	107	02	16	107	01	79
107	02	15	107	02	58	107	02	11
107	02	56	107	02	64	107	02	12
107	03	09	107	02	65	107	02	53
107	02	28	107	03	44	107	02	55
107	03	29	107	03	45	107	02	57
107	03	33	107	03	47	107	02	60
107	03	38	107	03	59	107	02	62
107	03	43	107	04	35	107	02	63
107	03	51	107	04	36	107	02	66
107	03	61	108	01	02	107	03	25
107	03	64	108	01	03	107	03	42
108	01	01	108	01	05	107	03	66
108	01	11	108	01	06	107	03	70
108	01	34	108	01	08	107	04	06
108	03	02	108	01	10	107	04	20
108	03	33	108	01	14	108	01	04
108	03	44	108	01	15	108	01	07
108	03	55	108	01	18	108	01	09
108	03	56	108	01	24	108	01	12
108	03	61	108	01	27	108	01	16
111	01	05	108	03	01	108	01	17
111	01	08	108	03	03	108	01	19
111	01	10	108	03	05	108	01	22
115	01	01	108	03	06	108	01	25
115	01	02	108	03	07	108	01	26
115	01	03	108	03	15	108	01	28
107	01	59	108	03	16	108	01	29
107	01	92	108	03	17	108	03	04
107	03	21	108	03	18	108	03	08
107	03	48	108	03	20	108	03	09
107	03	63	108	03	21	108	03	10
108	01	49	108	03	22	108	03	11

Appendix 1, continued

Comp.	Sub-comp.	Stand	Comp.	Sub-comp.	Stand	Comp.	Sub-comp.	Stand
	Low			Moderate			High	
109	02	16	108	01	52	107	03	03
109	02	18	108	01	54	107	03	04
109	02	25	108	01	58	107	03	05
109	02	26	108	01	59	107	03	07
109	02	31	108	01	62	107	03	16
109	02	34	108	01	63	107	03	24
109	02	35	108	01	64	107	03	27
109	02	36	108	01	66	107	03	30
109	02	38	109	03	25	107	03	31
109	02	40	109	03	27	107	03	35
109	02	41	109	03	30	107	03	36
109	02	42	109	03	32	107	03	46
109	02	57	109	03	33	107	03	54
109	03	01	109	03	34	107	03	69
109	03	02	109	03	35	109	03	31
109	03	03	109	03	38	109	01	43
109	03	04	109	03	39	109	01	45
109	03	05	109	03	40	109	01	46
109	03	06	109	03	47	109	01	48
109	03	08	109	03	50	109	01	49
109	03	09	109	03	57	109	02	04
109	03	10	110	01	08	102	02	39
109	03	14	110	01	09	102	02	45
109	03	15	109	02	01	102	02	49
109	03	16	109	02	03	102	02	52
109	03	17	109	02	05	102	02	53
109	03	18	109	02	06	102	02	54
109	03	19	109	02	07	102	02	55
109	03	20	109	02	11	102	02	58
109	03	22	109	02	13	102	02	59
109	03	23	109	02	15	102	02	60
108	01	67	109	02	17	109	03	07
109	02	30	109	02	20	109	03	13
111	01	05	109	02	21	109	02	43
111	01	06	109	02	22	109	02	47
111	01	07	109	02	23	109	02	50
111	01	09	109	02	24	109	02	51
			109	02	32	109	02	61
			109	02	33	109	03	63
			109	02	56	109	03	64
			109	03	11	109	03	67
			109	03	12	109	03	68

Appendix 1, continued

Comp.	Sub-comp.	Stand	Comp.	Sub-comp.	Stand	Comp.	Sub-comp.	Stand
Low			Moderate			High		
108	01	60	108	03	23	108	03	12
108	01	61	108	03	28	108	03	13
109	03	24	108	03	31	108	03	14
109	03	26	108	03	45	108	03	19
109	03	29	108	03	47	108	03	24
109	03	36	108	03	48	108	03	25
109	03	37	108	03	49	108	03	26
109	03	41	108	03	50	108	03	27
109	03	42	197	03	51	108	03	29
109	03	43	108	03	52	108	03	30
109	03	44	108	03	53	108	03	32
109	03	45	108	03	54	108	03	34
109	03	46	109	01	08	108	03	34
109	03	48	109	01	09	108	03	36
109	03	49	109	01	10	108	03	37
109	03	51	109	01	12	108	03	38
109	03	52	111	01	06	108	03	39
109	03	53	111	01	07	108	03	40
109	03	54	111	01	09	108	03	41
109	03	55	107	01	20	108	03	46
109	03	56	107	01	21	108	03	57
109	03	58	107	01	24	108	03	58
109	03	59	107	01	26	108	03	59
109	03	60	107	01	27	108	03	60
109	03	61	107	01	31	108	03	62
109	03	62	107	01	49	108	03	64
109	03	65	107	01	55	109	01	07
110	01	01	107	01	58	109	01	40
110	01	02	107	01	64	109	01	41
110	01	04	107	01	68	116	05	01
110	01	05	107	01	73	107	01	19
110	01	06	107	03	06	107	01	25
110	02	03	107	03	37	107	01	33
111	01	01	107	03	50	107	01	34
111	01	02	107	03	65	107	01	35
111	01	03	107	03	67	107	01	54
111	01	04	108	01	44	107	01	56
109	01	44	108	01	45	107	01	66
109	02	02	108	01	46	107	01	88
109	02	10	108	01	47	107	01	96
109	02	12	108	01	48	107	03	01
109	02	14	108	01	50	107	03	02

Appendix 1, continued

Comp.	Sub-comp.	Stand	Comp.	Sub-comp.	Stand	Comp.	Sub-comp.	Stand
Low			Moderate			High		
			109	03	21	109	03	69
			108	01	66	111	01	04
			109	02	19			
			109	02	44			
			109	02	46			
			109	02	48			
			109	02	71			
			109	03	66			
			109	03	70			
			109	03	71			
			109	03	08			